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MANUFACTURE OF GUTTA PERCHA.

THE following remarks from an English periodical, upon one of the most useful articles recently discovered, and applied to an immense variety of purposes, will, we doubt not, be read with interest:—

We live in eventful times; and every day brings to light some new discovery in science and the arts, or some special application of hitherto known but unappreciated agents. Here, a flash of the electric spark conveys intelligence from point to point, over mountains and through the very sea itself; there, the discovery of a new law in nature robs romance of half its charms, and explains, in part, the dreamy superstitions of our ancestors; everywhere the mind of man is active and awake, and ready to receive new impressions. Indeed, one of the most remarkable characteristics of the age in which we live is an inquiring spirit, which, in some cases, amounts almost to blameable credulity. Within the memory of living men, steam and gaslight, electricity and galvanism, photography and mesmerism, were unknown agencies to the great mass of the people; and it is only within the last ten years that the substance called "Gutta Percha" has become a useful application in domestic life.

We purpose, aided by the pencil of the artist, to record briefly the history and uses of this curious vegetable gum. Let us glance at the

GUTTA PERCHA IN ITS NATIVE WOODS.

Like photography and the new planet, this product seems to have had more than one discoverer—Dr. Montgomerie, assistant-surgeon to the Presidency at Singapore, and Mr. Thomas Lobb, botanical agent to the Messrs. Veitch, the well-known florists of Exeter, each claiming the discovery as his own, though each was miles distant from, and acting independently of, the other. Priority of discovery, however, seems by common assent to be given to the first-named gentleman. The home of the gutta percha tree is in the islands of the Indian Archipelago, where there is reason to believe that it is indigenous. In the year 1824, Dr. Montgomerie was out in the woods at Singapore, when he observed, in the hands of a *parang*, or native woodsman, a hatchet, the handle of which was composed of a strange substance. "I questioned the workman, in whose possession I found it," says the Doctor, in his account to the Society of Arts, "and heard that the material of which it was formed could be moulded into any form by dipping it into hot water, when it became as plastic as clay, and when cold regaining its original hardness and rigidity." Subsequent inquiry led to the fact that gutta percha, like caoutchouc, or india-rubber, is the sap of a species of sapaceous forest tree, thousands of which abound in the dense forests of the Malay peninsula. Our engraving will convey a good idea of its noble proportions.

Of course, the Doctor was not long in disseminating his knowledge of so remarkable a substance. He speedily procured specimens of the tree and its product in various states of preparation, and forwarded them to the Society of Arts in London. As soon as it arrived in this country, its peculiar properties were rigidly inquired into; and, its value in manufactures being speedily ascertained, the gold medal of the Society was awarded to the Doctor as the first discoverer.

This substance derives its name, not from the scientific world—though it is curious that the first half of the term is the Latin word for *drop*, whence it might be concluded that gutta percha meant the *droppings* of the percha tree—but from the native Malays. It is pronounced *pertsha*, not *perka*.

Dr. Montgomerie had several opportunities of becoming acquainted with the method by which the gutta or sap was obtained from the tree. The fruit yields a "concrete and edible oil, which is used by the natives with their food;" while the sap circulates between the bark and wood of the tree in vessels whose course is sufficiently well marked by black longitudinal marks. At first the natives were in the habit, when they required a supply, of felling the tree; but experience soon taught them that the milky juice might be collected

by cutting notches here and there in the trunk, and that in this way the life of the tree might be saved for future "tappings." The sap coagulates in a few minutes after it is collected; but before the crude gum becomes quite hard, it is kneaded by hand into compact oblong masses from seven to twelve inches in length, by four or five in thickness. This part of the work is mostly performed by women, as seen in the engraving. The blocks made up for exportation, however, are not always of uniform size and appearance, the fancy of the rude barbarian sometimes giving them strange forms—such as that of a bird with red berries for eyes, images of ships, quadrupeds, or the "human face divine." The gum is always sold by weight—a fact which is taken advantage of by the crafty savage, who, in humble imitation of more clever adulterators, sometimes introduces a stone or a heavy substance into the interior of the mass. As it would entail a serious loss of time on the merchant if he were to cut each block at the port of shipment, it often happens that, on the substance reaching this country, it is found to conceal stones or rubbish; and then woe to the purse and the cutting-knives of the purchasers! Besides this, however, the block often contains a vast amount of unavailable material in the shape of bark, dirt, leaves, and so on, which become accidentally incorporated with the gum.

From the examination of the specimen sent over by Dr. Montgomerie, it became apparent that a large trade in the article would speedily take place; and in a few months the jungles of the Johore Archipelago, the scene of the first gatherings, were explored by Englishmen, Chinese, and Malays, in search of the gum-exuding tree. Their efforts were actively seconded by the natives; and in a short time it was discovered that the supply, of which some doubts had at first been entertained, was almost inexhaustible. It is singular, remarks an acute observer, that, although the Portuguese, Dutch, and English, had, one or other of them, retained possession of the islands on which the trees grow for more than nine centuries and a half, it should have remained for an Englishman to discover their valuable properties at so late a date as 1843.

The rise of this new trade gave a great impulse to the activity of the Oriental islanders; and the value of the gum—becoming fully known, eager search was made from island to island, and among the forests of the Archipelago; and large profits were made by the sarmingongs, or chiefs, of the aboriginal tribes, who exacted from the gum-hunters a royalty on all they found. Sufficient profit, however, was left, even after this deduction, to stimulate the cupidity of the natives, and the port of Singapore was speedily supplied with the article in great quantities. At present, above two millions of pounds are exported into this country in the many-shaped masses alluded to. We will now inquire into

THE NATURE AND APPLICATIONS OF GUTTA PERCHA.

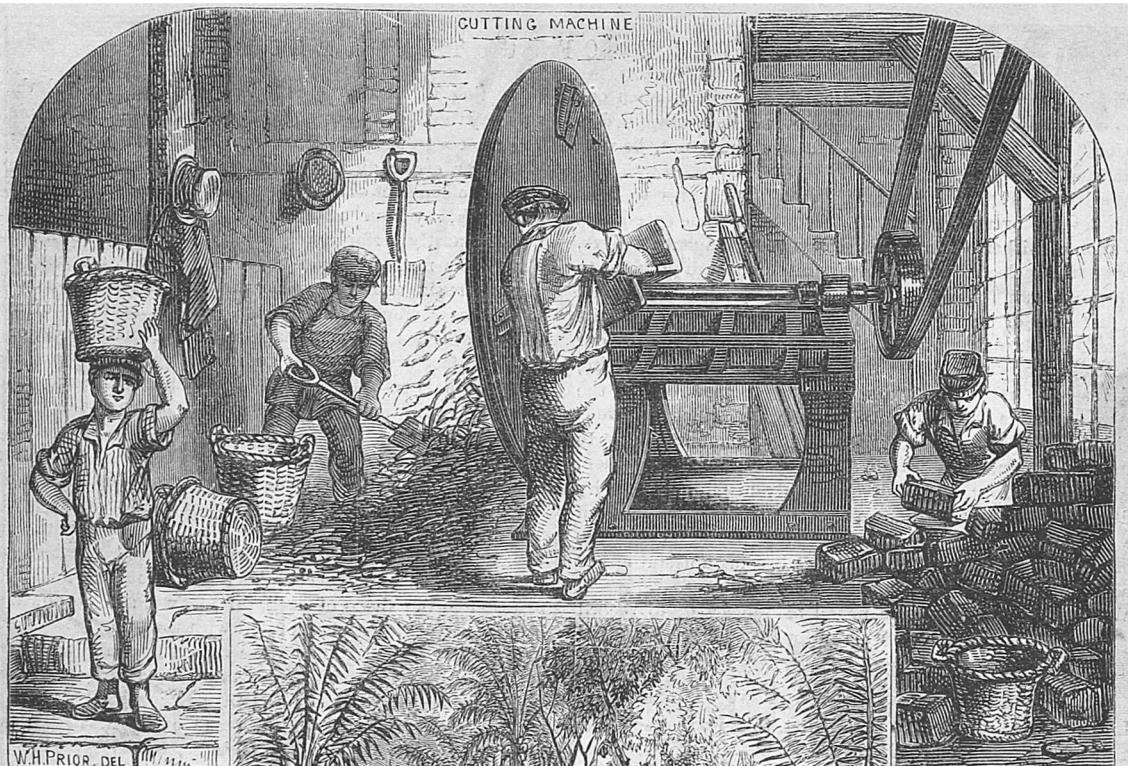
At the present time the chief supplies of the article come from Singapore, though vast numbers of the tree—the wood of which, being of a soft spongy nature, is of little commercial value—are found in Borneo, Java, Sumatra, and Penang. In its nature it differs from india-rubber chiefly in its superior density and toughness. Though both substances are somewhat alike in appearance and manner of application, the absence of oxygen in india-rubber may account for its greater elasticity. The chemical constituents of gutta percha, as ascertained by Dr. Maclagan, are—

Carbon ...	...	...	86.36
Hydrogen	...	...	12.15
Oxygen...	...	...	1.49
			— 100

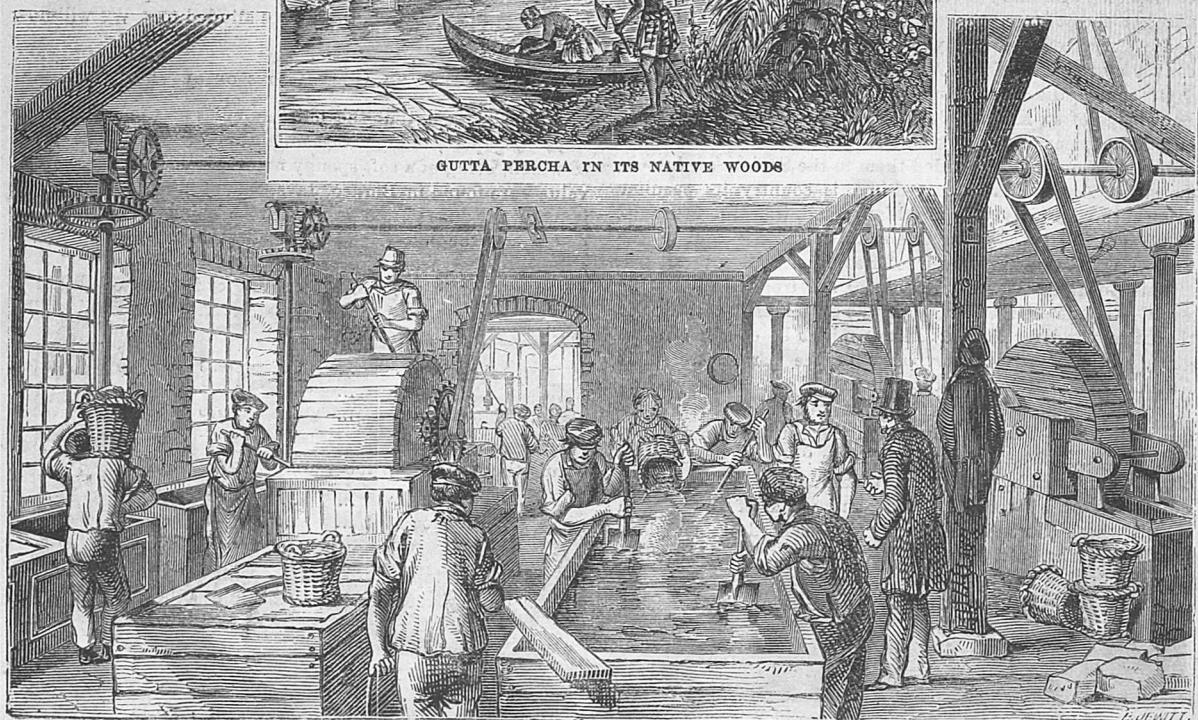
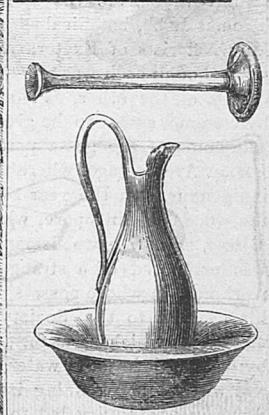
While those of india-rubber are—

Carbon ...	...	...	87.2
Hydrogen	...	...	12.8
			— 100

Exposed to a temperature of 248 degrees, gutta percha melts; and in cooling remains in a semi-fluid adhesive state—par-



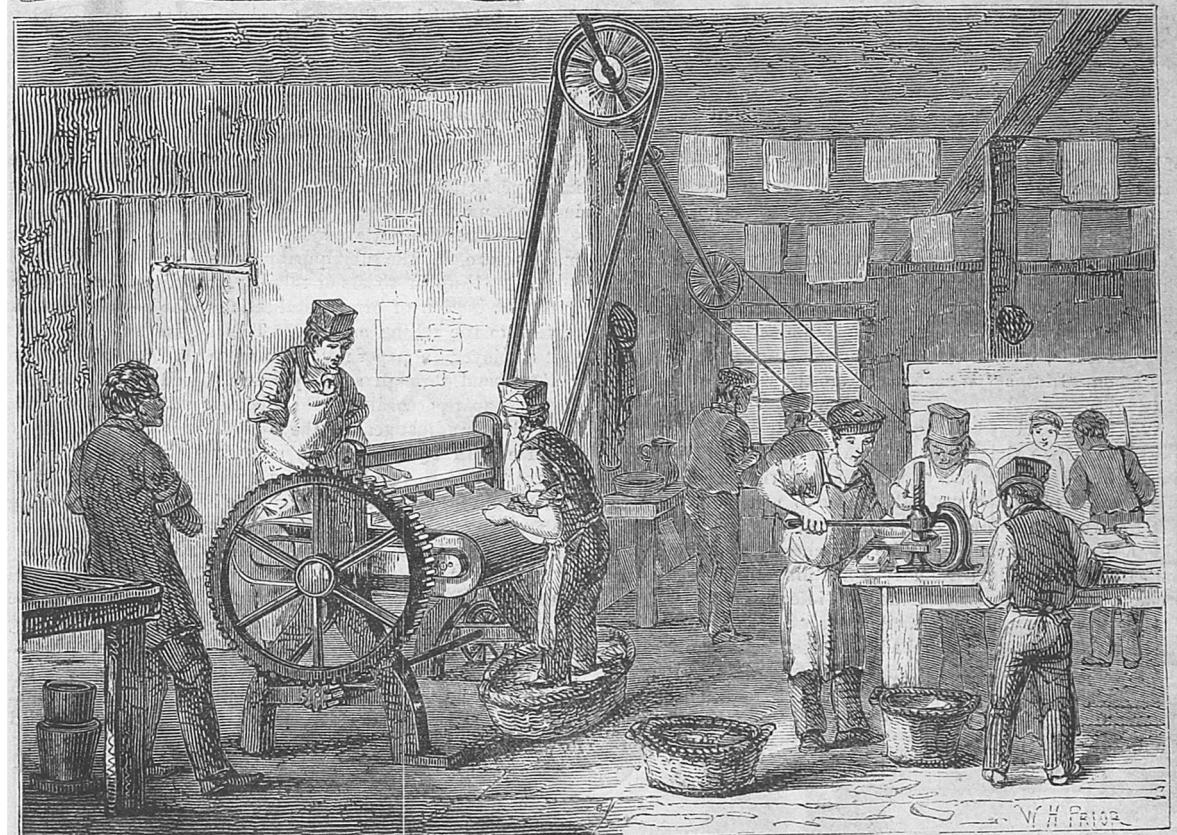
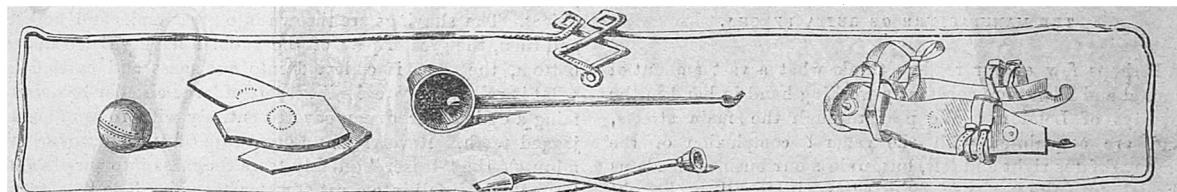
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GUTTA PERCHA—BOILING ROOM AND “TEASER.”



GUTTA PERCHA—ROLLING MACHINE AND TANK.



GUTTA PERCHA—SHAPING AND CUTTING ROOM.

tially decomposed, in fact; and when set on fire it burns very readily, with a dense smoke. At a temperature of about 200 degrees it becomes soft and ductile, though without stickiness, and can be put into the shape it is intended to retain when cool. Its specific is 975, that of water being 1000. It is a repellent of, and completely unaffected by, any description of cold water; and of heat and electricity it is a non-conductor. It is proof against alkalis and acids, being only affected by sulphuric or nitric acid in a highly concentrated state; while the most powerful ascetic, hydrofluoric, or muriatic acids, or chlorine, have no effect whatever on its structure or capabilities. Of its power to resist frost, sufficient proof exists in the number of boot and shoe-soles manufactured from it; and of its acoustic properties we shall have more to say.

The capabilities of the resin were tested as soon as the specimen forwarded by Dr. Montgomerie reached London, and a kind of historical interest is attached to this sample from the fact that, from this humble beginning, a large branch of manufacture has arisen which now employs some thousands of workmen. Several ingenious tests were applied to the specimens, and it was soon proved, by Messrs. Whishaw and Hancock, that it was applicable to a vast number of purposes; and from it were made tubing, lathe-bands, and impressions of medals—all of which were shown at the late Exhibition in Hyde-park. If further proofs of its value were necessary, we need only refer to the experiments made by these gentlemen; one of which consisted in the softening a mass of the material in hot water, pressing it round a soda-water bottle, hardening it in cold water, pressing it out into a thin sheet, and then, by the application of heat, again rolling up the gum into the form at first assumed. From the patents taken out by Messrs. Hancock, arose the manufacturing and trading firm known as the "Gutta Percha Company."

We will now examine

THE MANUFACTURE OF GUTTA PERCHA.

Perhaps few of our readers think what a vast amount of capital and labour are constantly working hand in hand in the byways of London. We pass through the main streets, and are acquainted with the general complexion of the thoroughfares right and left, but, unless our business leads us directly into the vortex of industry, we bestow little thought upon aught that comes not immediately before our eyes. A few steps out of the main line in one direction take us into the midst of the tan-yards of Bermondsey; a hundred yards or so from Finsbury-square, and we are in a new world among the weavers of rich silken and velvet stuffs; through a street or two from that same square, and we are deafened by the clang of hammers and the din of labour; in every direction, did we care to search, we should find factories where hundreds of men earn the "daily bread" for which, it is to be hoped, they nightly pray. So it is with the spot in which the Gutta Percha Company have their factory. A few yards out of the City-road, near the canal basin, and we find ourselves in a strange neighbourhood, where coals, and lime, and culm, and building materials, are being constantly unloaded from queer-shaped vessels, and where numerous manufactures are being carried on. In this "Wharf-road" are the works we are now visiting.

We enter a modest-looking doorway beside a pair of folding gates, on which the words "Gutta Percha Company" are painted, and we become speedily aware that a branch of manufacture of which we hitherto knew next to nothing is being carried on within. Sight and smell—a smell something like a tan-yard, something like old cheese, something like half-dried clothes in a laundry, something like gas-tar—an odour we soon become accustomed to—informs us that we may expect to witness a new sight. And we are not mistaken; for the manufacture of gutta percha has necessitated the invention and use of novel machines, strange processes, and odd-looking tools. Every fresh application of the material—whether it be the production of merely useful or highly ornamental designs, the imitation of the grain of wood, the close texture of paper-

maché, or the endeavour to make this Eastern gum a substitute for leather—has necessitated the invention of tools not hitherto thought of, and the use of appliances beyond the range of the ordinary workman. As soon as we are fairly in the yard of the works, we look around and read the history of the manufacture all about us. Here are piled great heaps of the raw material, in all imaginable strange shapes; there, and on every side, are buildings erected especially for the processes to be carried on inside—store-rooms, engine-houses, workshops, a quay for unshipping the gum, *cum multis aliis*.

Let us enter the building nearest us, and, by the help of Mr. Statham, the intelligent manager, and "our own artist," we will endeavour to explain what we witness. The blocks of gutta percha required for use are taken from this heap to the cutting machine. This is a large solid vertical disc of iron, making about two hundred revolutions per minute. The raw material is cut into thin slices by several sharp knives, like those in a carpenter's plane. The block of gutta percha, being brought to the edge of a sloping iron table, is rapidly caught up by the knives, and literally reduced to shavings, which fall into a receptacle beneath. The cutting apparatus, as well as the other machines on the premises, is put in motion through the agency of two fifty-horse power engines, the boilers of which are constructed on a novel plan, by which eleven pounds of water are evaporated to one pound of fuel. The furnaces, moreover, consume their own smoke. A reference to the engraving will convey a good idea of the appearance of the cutting machine; and we may remark, in passing, that the stone and other adulterative material which the cupidity of the Malay gatherers has added to the mass, are discovered by this process, often very much to the injury of the cutters.

Reduced to shavings, the gutta percha must next be perfectly cleansed of its impurities. This is no easy matter, but patience and hot water are certain at last to effect the desired object. The shavings are thrown into great tanks and boiled, and then, the greater part of the rubbish having fallen to the bottom, the gum is collected into one mass and carried to what is called the "teaser"—a sort of large circular box, containing a cylinder or drum, covered entirely with rows of bent, jagged teeth. Revolving at a great rate (about 800 turns in a minute), the "teaser" quickly tears the mass into shreds and tatters, which fall into a vat of water beneath. The true gutta percha, being lighter than water, floats on the surface, while the impurities sink to the bottom; and thus, being perfectly cleansed of all impurities, is ready, crisp and new-looking, for the succeeding process. Another boiling brings the material again into a soft, compact mass, which is "kneaded" or "masticated" in heated iron cylinders, in which revolving drums so completely turn and twist the pasty gum as to bring it into a perfectly homogeneous state, without a particle of water in its composition.

In this state the gutta percha may be considered ready for manufacture, and the subsequent processes are employed either in making it up in sheets or tubes. If required for after use in the production of ornamental articles, the kneaded mass is carried to the rolling machine. This apparatus is similar to that employed in paper mills, the gutta percha passing on an endless band through steel cylinders placed at the requisite distances apart, according to the thickness of the sheet required. By a simple adjustment of the cylinders, it can be made to produce with equal ease the stoutest driving-band or the thinnest tissue so much used and appreciated by surgeons as a substitute for oiled silk, hydropathic bandages, etc. During the passage of the sheet through the machine, it has become sufficiently cooled to form a solid consistent body; or if the substance of the sheet required be too thick to allow it to cool in the ordinary manner, it is blown upon as it passes on to the drum at the end by a series of fans, like those in a winnowing machine. When the material is required to be in strips, a very ingenious construction of knives takes the sheet just before quitting the machine, and cuts it into longitudinal bands of the required width, which are, as before, carried forward on to the drum.

In the production of tubing, a different but highly ingenious and simple process takes place. "A mass of the softened material is forced by a piston through a steel cylinder, terminating in a mould, which consists of a solid circular piece of metal set within an iron tube, the space between the two being the thickness required;"—in fact, this is a very curious modification of the wire-drawing process. The gutta percha, after having left the mould in a tubular form, is received into a canal of water about fifty feet in length. The office of the water is to prevent the tube from contracting or collapsing; the pressure being equal both within and without, it is thus preserved in the required shape, and is afterwards dried and hardened by exposure to the air. As the tube leaves the water it is wound off at the other end, and the "feeding cylinder" is so contrived that no pause occurs in the transmission of the material. By this means a pipe of upwards of 1,000 feet in length has been manufactured in one piece.

From the sheeting and tubing thus prepared an infinite variety of articles are composed. The numerous workshops are crowded with men and boys engaged in various operations. In the cutting and stamping room the paper-cutting machine, invented by Mr. Wilson, is brought into extensive operation, moulds of every description being used to produce the different articles; and so great is the demand for new combinations of gutta percha, that scarcely a week passes without some addition to the stock of curious contrivances—some unique pattern, some elegant design, or some useful appliance. As we said before, the novelty of the manufacture has introduced a vast number of curious looking tools, etc.; but it may be affirmed that the principal and indispensable necessities are, boiling water, the knife, the mould, the press, and the plastic hand of the workman. The operation of the cutting machine is as instantaneous as it is curious. If shoe-soles are required, the band is applied to the machine, and a dozen pieces of one shape is the result; if line or string is wanted, a series of sharp knives press down on the material, and the necessary quantity is ready for the workman's hand to roll and polish; and so of every article in which a distinct outline is necessary.

The next process is the moulding or stamping. The sheets are cut into pieces, and each piece is warmed sufficiently to take the impress of the die. These moulds, many of which display great ingenuity and originality, are all made on the premises, and constitute a distinct branch of the company's operations. We come now to speak of

THE USES OF GUTTA PERCHA.

The most important use to which this material has been applied is undoubtedly that of tubing. The history of water-carrying is the history of civilisation. First the spring at which the wayfarer stooped to drink; then the rude passage formed of trunks of trees laid end to end; then the aqueduct, carried o'er hill and valley to imperial Rome; then the gay, splashing fountain, with its retinue of water-carriers; lastly, the leaden pipe, which does its office stealthily beneath the earth, and bears the stream from distant country places into our very homes. But even the reign of the leaden pipe is doomed, and must give way in turn to gutta percha. Even while we write, the system of supply for large cities is undergoing change, and medical men are beginning to perceive that the conveyance of water in leaden pipes is hurtful to the health. "Many serious and alarming disorders," says Dr. Thomas Smith, "such as mania, epilepsy, sudden death, nervous affections, paralysis, consumption, hydrocephalus, heart disease, etc., owe their origin, in some instances, their intractable character in others, to the gradual and continuous infinitesimal doses of lead, copper, etc., introduced into the system through the channel of our daily drink." For all sanitary purposes the gutta percha tubing is admirably adapted, as it possesses strength, purity, and is entirely unaffected by frost. It is accordingly extensively used for pump-barrels, ship-pumps, fuel-pipes, for locomotive engines, siphons for mines, suction-pipes for fire, garden, and washing engines; and, being unaffected by acids, is available for bleaching and all chemical

purposes. It may be united to a metal pipe without difficulty; is unhurt by gas or chlorine; and, as for strength, it has been found to resist a pressure of 200 lbs. to the square inch. At New York a gutta percha pipe of 1,000 feet in length, and of but two and a half inches calibre, has been laid down for conveying the Croton water from Blackwell's Island. Its durability has been proved by the fact of its having lain in damp ground quite uninjured for two years, and its ductility is seen in the fact that it may be bent, twisted, or coiled in all directions without injury. A curious and valuable use has been made of the gutta percha tube in illuminating buildings. One end being attached to a gas-pipe, and the rest coiled round a cylinder, the light may be carried about by hand to any part of the building, the tube being coiled and uncoiled at pleasure.

Formed into carboys, flasks, funnels, bowls, scoops for ladles, linings for cisterns, battery-cells, buckets, troughs, or siphons, the Indian gum answers its purpose equally well, and is found far more strong and economical than any material hitherto tried.

In acoustics the gutta percha tubing has been found of admirable service; and whether employed as an ear-trumpet for the deaf; as a speaking tube in a railway carriage; a domestic telegraph by which messages may be conveyed from one part of the house to another, and whereby the lowest whisper is distinctly heard; a speaking apparatus from the mouth to the lowest depths of mines; or as an appliance whereby a minister may address the deaf among his congregation—it has been found equally certain and unfailing. In various churches and chapels it has been applied to the latter purpose, being conveyed under the flooring from the pulpit to the most distant pews; and in more than one instance it has been attached to the doorway of the medical man, and carried up to his bedside, so that he is enabled to communicate with the messenger of his patients as readily as if he attended them in person in the cold night air.

For shoe and boot-soles it has been extensively applied, and numerous testimonial speak of its efficacy in resisting damp, and protecting the feet from cold and frost in all situations. As a substitute or addition to leather for these purposes it is undoubtedly of great and important use.

We would willingly speak at length of its services in telegraphic communication; but when we say, as is already known to all our readers, that through its agency the British Channel has been spanned, and Paris, and Berlin, and Brussels have been brought within speaking distance of London; when by a flash of lightning the submarine telegraph conveys intelligence from shore to shore, we think we have sufficiently testified to its usefulness and importance in this respect.

As a decorative and fine art material, gutta percha has been brought into use in an immense variety of ways. In gutta percha are formed all manner of domestic appliances and ornaments—trays of all sorts and sizes; vases, watch-stands, and plates; bouquet-holders, statuettes, brackets, jugs, mugs, inkstands, and clothes-lines; flower-pots and stands, paper-weights, medallions, cornices, doors, mouldings, picture and glass frames, drinking cups, fishing nets, and portmanteus; skates, policemen's batons, and boats; oil-cans, washing basins, and whips; stethoscopes, splints for dislocations, and curtain-rings; stuffing for horses' feet, mill-bands, and stop-cocks; cutting boards, cabmen's hats, and traces; life preservers, bottling boots, and seals; powder-flasks, air-guns, and book-covers; sponge-bags, galvanic batteries, and bandages for broken limbs. For all these, and thousands of other purposes, it has been found of eminent utility, and we think enough has been said to commend it to the reader's attention. It may be mentioned, in conclusion, that many imitations and falsifications of the company's patent have been attempted, to obviate which the names and offices of the patentees are now stamped on all articles issuing from their establishment. We could go on, but space forbids. To the stranger in London, and the seeker after novelty in manufactures, an hour or two cannot be more profitably spent than in visiting the works of the Gutta Percha Company. Much that is useful, much that is curious, and much that is beautiful, awaits his inspection.